UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/722,946	11/26/2003	Timothy A. Bekkedahl	C-2370B	9625

7590 12/22/2006

M.P. Williams
210 Main Street
Manchester, CT 06040

EXAMINER	
WILLIAMS, SHERMANDA L	
ART UNIT	PAPER NUMBER
1745	
MAIL DATE	DELIVERY MODE
12/22/2006	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/722,946	BEKKEDAHL ET AL.	
	Examiner	Art Unit	
	Shermanda L. Williams	1745	

-- *The MAILING DATE of this communication appears on the cover sheet with the correspondence address* --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *04 October 2006*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-5* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) *1-3* is/are allowed.

6)☒ Claim(s) *4 and 5* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *26 November 2003* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☒ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

Response to Amendment

This Office Action is responsive to the Amendment After Non-Final Rejection filed on 10/10/2006. Claims 1-3 are allowable for the reasons as stated in previous correspondence dated 6/7/2006 and claims 4 and 5 are rejected below. The amendment to the specification is acknowledged.

Response to Declaration and *Arguments*

The applicants arguments filed 10/4/2006 have been considered and are persuasive. The rejection of claims 4 and 5 based on the introduction of new matter is withdrawn.

The Declaration under 37 CFR 1.132 filed 10/4/2006 is sufficient to overcome the rejection of claims 4 and 5 based upon the introduction of new matter as set forth in the last Office action because: Figure 11 of applications 09/466,701; 10/012,157; and 10/722,945 displays a plot of the cell voltage versus the pressure difference between the cathode gas and coolant covering a pressure difference range from 0 to approximately 4.4. Data points for the claimed range of 0.2 to less than 1.7 are included in Figure 11 and were presented in all 3 applications named above. Therefore the specification does support a pressure difference range of 0.2 to less than 1.7. Therefore, the rejection of claims 4 and 5 under 35 U.S.C. 112, first paragraph is withdrawn.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

Claims 4 and 5 are rejected under 35 USC 102(e) as being unpatentable over Dufner et al. (US 6,024,848). Dufner et al. (Dufner) discloses a fuel cell comprising the following components:

a membrane electrode assembly comprising a polymer electrolyte membrane (30) and is positioned between two substrate layers (a porous anode support plate and a porous cathode support plate) See **46** and **50** of Figure 2. Each of the support plates (stated as substrate layer by Dufner) contain discrete porous hydrophilic and hydrophobic regions (Column 5 Lines 27-53, Column 8 Lines 25-59)

each porous anode and cathode support plate having a contact bi-layer or "diffusion layer" disposed between the membrane electrode assembly and the hydrophilic substrate layer of the anode support plate and the cathode support plate, each contact bi-layer compromises hydrophobic gas passages and hydrophilic liquid passages (Column 5 Line 36-46, Column 6 Line 24-31) See **44** and **48** of Figure 2. It is noted that Claim 5 does not require the existence of the diffusion layer disposed between the membrane electrode assembly and at least one hydrophilic substrate layer. Due to the open claim language, this reference meets the limitations of claim 5.

a first and second water transport plate adjoining the anode support plate and the cathode support plate in that order (Column 5 Lines 52-60), and each water transport

plate has a passageway for a coolant stream and a passageway for a reactant gas stream; See **60** and **66** of Figure 2.

Each fuel cell has a means for creating a predetermined pressure differential between the coolant stream and the reactant gas stream. The reactant gas stream passes through the water transport plates at a pressure that is about 2-3 psi greater than the coolant stream passing through the water transport plates. (Column 8 Lines 19-25). Dufner dose not explicitly express that the pressure differential is in the range of "more than 0.2 psi and less than 1.7 psi". However, Dufner does disclose that the pressure differential is about 2-3 psi. (Column 8 Lines 19-21). The range of about 2-3 psi differential includes "more than 0.2 psi and less than 1.7 psi". See *Wertheim, 541 F.2d 257, 191 USPQ 90 (CCPA 1976)*

A pressure differential of about 2 psi as disclosed by Dufner et al. is expressed as one significant figure and encompasses 1.5 to less than 2 psi. A pressure differential of 1.5 to 1.7 is about 2 when expressed as one significant figure.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 4 and 5 are rejected under 35 USC 103(a) as being unpatentable over Dufner et al. (US 6,024,848) in view of Reiser (US 5,853,909) and Fredley (US 5,998,058).

Dufner et al. (Dufner) as discussed above discloses an electrochemical cell with a porous support plate operating with a pressure differential that is about 2-3 psi. Dufner does not explicitly state the operating pressure difference range is 0.2 to less than 1.7 psi. Reiser et al. (Reiser) discloses an ion exchange membrane fuel cell power plant with water management pressure differentials. The fuel cell of this reference employs a water management system consisting of fine pore plate assemblies, water transport plates. (Column 2 Lines 5-27) The water transport plates have oxidant, fuel gas and coolant channels (Column 3 Line 56-59).

The general operating conditions require that the oxidant reactant gas be pressurized to a pressure that exceeds the coolant loop pressure by a predetermined pressure differential. The oxidant reactant (cathode) flow fields are maintained at a pressure greater than that of the coolant water flow fields to ensure movement of product water from the cathode side of the membrane to the coolant flow field. This is predetermined pressure differential 1. Also, the reactant fuel gas (anode) flow fields are maintained at a pressure greater than that of the coolant water flow fields to ensure delivery of coolant water to the anode side of the membrane to keep it from drying out but without flooding occurring. This is predetermined pressure differential 2 (Column 2 Line 27-50 and Column 4 Lines 46-60) See Figure 3.

Reiser teaches that the predetermined pressure differential settings may vary depending on the plant size, power output, internal pressure of the reactants, and the like. (Column 4, Line 63) Riser also discloses that the correct pressure differentials are needed for the proper operation of the power plant. It is commonly known in the art

that as the fuel cell operates, hydrogen ions travel through the cell membrane and water is carried over with the hydrogen ions. This presents two problems that have to be addressed, flooding of the cathode side of the membrane and the drying out of the anode side of the membrane. The occurrence of either of these problems can result in malfunction of the power plant. (Column 1 Lines 15-30) Therefore, any predetermined pressure differential values that do not alleviate these problems may result in poor performance of the power plant. Therefore, Reiser discloses that the pressure differential at both the cathode and anode side of the fuel cell is a results effective variable.

Fredley teaches a porous support layer for an electrochemical cell. Fredley does not explicitly teach that the pressure differential between the coolant and the reactants is 0.2 to less than 1.7. Fredley teaches that it is known in the art to add porous water transport plates adjacent the support layers to facilitate liquid water transport and cooling within the cell (Column 3 Lines 3-5). A pressure differential is generated on the anode side of the cell by maintaining the reacting gases at a slightly higher pressure than the coolant water and anode supply water passing through the porous support layers (Column 3 Lines 20-26). This pressure differential aids in the water transport through the porous support layers of the cell.

Therefore, it would have been obvious to one having ordinary skill in the art at the time of the invention was made to vary the independent and by association the dependent operating parameters (this includes operating pressure differentials 1 and 2) of the fuel cell as taught by Reiser and Fredley to ensure proper and optimal

performance of the power plant alleviating drying out of the anode and flooding of the cathode. Therefore it would have been obvious for one having ordinary skill in the art at the time the invention was made to combine the teachings of Dufner (who meets the claim limitations with the exception of explicitly stating the operating pressure range) and Reiser to produce a fuel cell having an operating pressure differential in the range of more than 0.2 psi and less than 1.7 psi to ensure proper operation of the fuel cell power plant by proper movement of water throughout the internals of the cell. It has been held by the courts that the optimization of results effective parameters is not novel. See Boesch, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

Allowable Subject Matter

Claims 1-3 are allowed.

Reasons for the indication of allowable subject matter are below:

The present invention claims a fuel cell having a partially hydrophobic porous carbon fluoropolymer particulate composite diffusion layer disposed between at least one hydrophilic substrate layer and the membrane electrode assembly where the diffusion layer comprises about 10 percent fluoropolymer by weight.

The closest prior art of record, Dufner et al. (US Pat. No. 6,024,848) discloses a particulate composite diffusion layer disposed between the hydrophilic substrate layer and the membrane electrode assembly. The diffusion layer comprises a hydrophilic phase as well as a hydrophobic phase. The hydrophilic phase comprises approximately 30 to 70 percent by weight carbon black and about 70 to 30 percent by weight of NAFION (a proton exchange resin which is a fluoropolymer). See Column 6, Line 51

through Column 7, Line 22). The hydrophobic phase comprises approximately 65 to 35 percent of a hydrophobic polymer by weight and 35 to 65 percent of carbon black by weight. However, Dufner et al. does not disclose or suggest that the total amount of the fluoropolymer material (to include NAFION and the hydrophobic polymer) in the diffusion layer is about 10 percent by weight of the diffusion layer.

The present invention also claims a fuel cell with a diffusion layer disposed between at least one of the hydrophilic substrate layer and the membrane electrode assembly with the thickness of the diffusion layer being within the range of more than 5 microns and less than 25 microns. The closest prior art of record, Dufner et al. (US Pat. No. 6,024,848) discloses a diffusion layer (**44** and **48** in Figure 2) between the hydrophilic substrate layer (**46** and **50** in Figure 2) and the membrane electrode assembly (**30**, **36**, and **38** in Figure 2) but Dufner et al. does not disclose or suggest that the thickness of the diffusion layer is in the range of more than 5 microns and less than 25 microns. On page 21 line 14, the applicant discusses the significance of the thickness of the diffusion layer in relation to the removal of product water.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Shermanda L. Williams whose telephone number is (571) 272-8915. The examiner can normally be reached on Mon.-Thurs. 7 AM - 4:30 PM and alternating Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Patrick Ryan can be reached on (571) 272-1292. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

PATRICK JOSEPH RYAN
SUPERVISORY PATENT EXAMINER

***